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ABSTRACT

This research study used a system of microcomputers interconnected with electronic meeting system software as a possible means of overcoming the grading and participation disparity problems associated with group work sessions conducted in face-to-face meetings. The purpose of the study of 20 undergraduate business students at the University of Northern Colorado was to determine the effect of computer-mediated communications on the productivity and the participation pattern of groups involved in collaborative problem-solving activities. As originally hypothesized, the results showed that students were more productive in accomplishing task objectives and participated more uniformly when working together using computer-mediated communications. It is noted that computer-mediated communications can function effectively as an alternative means of teaching collaborative problem solving, particularly when the instructor would like to be able to grade individual students' contributions. Several tables summarize the data. (Contains 5 references.) (ALF)

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Teaching Collaborative Problem Solving Using Computer-Mediated Communications

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Teaching Collaborative Problem Solving Using Computer-Mediated Communications

Faculties in schools of business are continually challenged to find relevant and effective ways of teaching management theory and practice to their undergraduate and graduate business majors. Besides the traditional content material on management principles, three additional areas of instruction need to be emphasized to adequately prepare these students for the professional roles they will be expected to fulfill in the business world. First, students need to become active learners, applying the principles they have learned. Second, students need practice solving "real world" problems presented in a complex framework. And third, students need experience working together as members of a team engaged in problem solving.

The business case studies that are commonly assigned as group projects in business management courses do serve to meet these educational needs. The typical format of such assignments requires the students to analyze the strengths, weaknesses, opportunities, and threats of a company, then identify strategic issues and formulate recommendations for that company. Students are either given or required to research the information on the history of the company and its industry, the company's mission and purpose, external environment, internal environment, product mix and characteristics, competitive market, and strategies used by the company to meet its goals.

There are some problems associated with these group case study assignments, however. Assigning grades to students can be problematic because the instructor cannot easily ascertain the contribution level of each student to the paper that was handed in. Even when the instructor has students identify their contributions to the report, grading inequities are difficult to avoid. Most instructors adopt the policy of giving all members of the group the same grade, based on the quality of their joint effort. Better teamwork may result, but the problem of grade inequities is not resolved by this approach.

In fact, the "single grade" policy may in and of itself intensify grade inequity problems by failing to provide any consequences for an unequal distribution of work load within the group. Some students will become "free riders," taking advantage of their teammates' determination to get a good grade on the assignment. Other students, who are highly motivated by grade and who lack confidence in their teammates, will take on a disproportionately large share of the assignment to assure that it is completed satisfactorily.

Another reason that all members of the group may not participate equally in work sessions relates to personality differences. Students who are outgoing and self-assured often dominate group discussions; students who dislike competing for the opportunity to be heard or who are uncomfortable defending their opinions tend to be reticent.

A system of microcomputers interconnected with electronic meeting system software was used in this research study as a possible means of overcoming the grading and participation disparity problems associated with group work sessions conducted in face-to-face meetings. Studies published by users of GroupSystems, an electronic meeting system software package developed at the University of Arizona, reported that computer-mediated communications tend to reduce dysfunctional personal interactions such as domination by some group members and participation avoidance by others, as well as increasing productivity for the group as a whole. Another advantage for the instructor is the feature in GroupSystems that provides the ability to print out a transcript of all communication interactions that occurred during the session, identified with each participant's name.

The purpose of this study was to determine the effect of computer-mediated communications on the productivity and the participation pattern of groups involved

in collaborative problem-solving activities. The expectation of the authors was that groups of students collaborating on case study analysis assignments would be more productive and would participate more uniformly when communicating with each other through networked computers than in a face-to-face meeting.

Method

Subjects

Twenty undergraduate business students at the University of Northern Colorado were used as subjects for this study. Five females and fifteen males comprised the group. All were enrolled in a senior-level "Strategic Management and Business Policy" class taught as a capstone course for business majors. The class was divided into five groups of four students each by arbitrarily assigning a marketing major, an accounting major, a management major, and one of the remaining students to each group. Each of the five groups was then randomly selected to be either an experimental group or a control group. Three groups were designated as experimental groups and two as control groups.

Materials

Case studies on four different corporations were prepared for use as collaborative problem-solving assignments. Each case study contained information about the history of the company and its industry, the company's mission and purpose, external environment, internal environment, product mix and characteristics, competitive market, and strategies used by the company to meet its goals. Group members were given copies of the case study prior to the group's scheduled meeting to produce a written analysis of the strengths, weaknesses, opportunities, threats, strategic issues, and recommendations for that company. Face-to-face group meetings were conducted in classrooms with the four students seated around a three-foot by five-foot table. The group meetings using computer-mediated communications were held in the Decision Support Center, a meeting room with twenty-one networked PCs running under GroupSystems V, an electronic meeting system software package marketed by Ventana Corporation in Tucson, Arizona. The "Topic Commenter" tool in the package was used, allowing students to enter their comments for each of the six analysis areas (strengths, weaknesses, opportunities, threats, strategic issues, and recommendations) and to view the comments of their teammates.

Procedure

The case study assignments used in this research were included as part of the class requirements and made up a substantial part of the class grade, assuring that students had adequate incentive to participate in the research study and to work seriously at the assignments. Students were told before each work session that all members of their group would receive the same grade--the grade they earned on their analysis paper. An objective of the research was to examine the participation patterns that occur when students have been told that all members of the group will receive the same grade. Therefore, students were not graded individually for these assignments even though the contributions of each student were identified and recorded during the study. Each group met three times, for 75 minutes each, to work on three different case studies. All of the group meeting sessions, including those in the Decision Support Center, were videotaped. The video camera was set up in advance and was left unattended in full view of the students. In the face-to-face group meetings, only the four members of the group were present in the classroom during the group meeting. In the computer-mediated group meetings, one or two system administrators were present in the Decision Support Center room with the four group members. The system administrators were present solely to facilitate use of the electronic meeting system software, staying in the background as much as possible.

The case studies for the four corporations were assigned to the five groups in a different sequence for each group to counterbalance any effect introduced by differences among the case studies in level of difficulty or in students' prior knowledge and beliefs about the corporation or the industry. Before beginning the case study assignments, an orientation session was conducted to familiarize all students with the use of the GroupSystems software and the work stations to assure that students were not inhibited by uncertainty about how to use the technology when working in the Decision Support Center.

The first case study assignment for each of the five groups was a face-to-face session that was used as a desensitization session, giving group members an opportunity to work together completing an assignment like the two that were to follow and to become accustomed to the video camera equipment. The next session for each of the experimental and control groups was also a face-to-face collaborative problem-solving session. The third session for the experimental groups was conducted in the Decision Support Center using computer-mediated communication. The third session for the control groups was conducted as another face-to-face session.

In each of the face-to-face meetings, the group prepared a hand-written report to turn in summarizing the group's analysis of the case by the six required categories. In the computer-mediated meetings, the group handed in the computer-produced printout of their comments segregated into the six case-analysis categories. The reports that were handed in were graded by the instructor and subsequently returned to the students after all case studies had been completed.

The first face-to-face meeting of each of the groups, the desensitization session, was not scored as part of the study data. The videotapes for each of the second group meetings of all five groups (all face-to-face meetings) were transcribed into scripts to facilitate scoring of the group interactions. Similarly, the videotapes of the third face-to-face meetings of the two control groups were transcribed into written scripts. All written materials that were prepared for scoring were edited to substitute numbers for student names and to remove any references to gender, race, or other features that might introduce scoring bias.

Each comment made by a student was scored as being one of three types: T to designate task-oriented comments that related directly to the analysis of the case study, G to designate group process comments that served to direct group effort or provided feedback in group activities related to the assigned task, and S to designate social and other non task-related comments. Within the T category, those comments that contributed directly, in a very focused way, to the task requirements were scored as T-1 comments. Seven videotape transcripts and three computer-mediated session printouts were scored and tallied. In the videotaped sessions, a count was also made of the number of task-oriented comments (T comments) that were interrupted by another group member. In some cases, the second individual talked over the first one's comment. In other cases, the first individual had not expressed a complete sentence or thought, but stopped talking (perhaps to search for a word) and the second individual took the floor.

Results

A summary of the data collected is presented in Table 1. A weighting factor was applied to scale the scores within each group for a standardized session duration, i.e., to 31 minutes, the duration of the shortest session. The three experimental groups were combined into a composite experimental group and the two control groups were combined into a composite control group after verifying homogeneity of variance between the groups (using Hartley's F_{max} test) and normalcy of distribution for each group (using a Kolmogorov-Smirnoff Test of Goodness of Fit).

A t-test of dependent observations was used on both composite groups to compare the difference in the number of T-1 comments (direct contributions to the assigned task). The experimental group showed a significant increase ($p<.05$) in the mean number of T-1 contributions in the computer-mediated sessions over the face-to-face sessions. No significant difference was found in the mean number of T-1 contributions between the two successive face-to-face sessions in the control group.

A t-test of paired variances was used to compare the variance of All T comments (all task-oriented comments) contributed within each group. There was a significantly smaller variance ($p<.05$) in the number of All T comments made in the experimental group's computer-mediated session than in its face-to-face session. No significant difference was found between the variance of All T comments made in the control group's two face-to-face sessions.

Table 1
Summary of Comment Category Scores for Experimental and Control Groups

GROUP 1: Treatment Group

	Duration: 47 minutes Face-to-Face Communication					Duration: 50 minutes Computer-Mediated Communication				
Student	T-1	All T	All G	All S	Total	T-1	All T	All G	All S	Total
1	5	37	7	3	47	19	19	-	-	19
2	17	61	46	2	109	13	13	-	-	13
3	11	63	24	5	92	17	18	1	-	19
4	11	37	11	1	49	10	12	1	-	13
	44	198	88	11	297	59	62	2	-	64
	15%	67%	30%	4%	100%	92%	97%	3%	0%	100%
	29 T comments interrupted									

GROUP 2: Treatment Group

	Duration: 64 minutes Face-to-Face Communication					Duration: 62 minutes Computer-Mediated Communication				
Student	T-1	All T	All G	All S	Total	T-1	All T	All G	All S	Total
1	0	2	1	-	3	29	29	-	-	29
2	18	102	29	9	140	35	38	3	1	42
3	27	107	48	5	160	37	37	-	-	37
4	15	95	76	7	178	22	22	-	1	23
	60	306	154	21	481	123	126	3	2	131
	12%	64%	32%	4%	100%	94%	96%	2%	2%	100%
	31 T comments interrupted									

GROUP 3: Treatment Group

	Duration: 31 minutes Face-to-Face Communication					Duration: 50 minutes Computer-Mediated Communication				
Student	T-1	All T	All G	All S	Total	T-1	All T	All G	All S	Total
1	17	51	10	3	64	51	52	-	-	52
2	14	36	15	1	52	36	37	-	-	37
3	5	41	8	4	53	15	16	6	-	22
4	9	33	7	2	42	27	27	-	-	27
	45	161	40	10	211	129	132	6	0	138
	21%	76%	19%	5%	100%	93%	96%	4%	0%	100%
	19 T comments interrupted									

GROUP 4: Control Group

	Duration: 76 minutes Face-to-Face Communication #1					Duration: 55 minutes Face-to-Face Communication #2				
Student	T-1	All T	All G	All S	Total	T-1	All T	All G	All S	Total
1	15	75	36	-	111	16	48	3	16	67
2	1	7	1	-	8	10	31	2	17	50
3	23	92	21	7	120	12	41	16	18	75
4	10	41	10	1	52	11	36	10	9	55
	49	215	68	8	291	49	156	31	60	247
	17%	74%	23%	3%	100%	20%	63%	13%	24%	100%
	28 T comments interrupted					16 T comments interrupted				

GROUP 5: Control Group

	Duration: 62 minutes Face-to-Face Communication #1					Duration: 48 minutes Face-to-Face Communication #2				
Student	T-1	All T	All G	All S	Total	T-1	All T	All G	All S	Total
1	6	87	17	9	113	4	66	11	32	109
2	16	67	24	11	102	21	87	22	20	129
3	4	35	10	5	50	6	28	12	10	50
4	28	128	70	11	209	13	78	39	30	147
	54	317	121	36	474	44	259	84	92	435
	11%	67%	26%	8%	100%	10%	60%	19%	21%	100%
	37 T comments interrupted					55 T comments interrupted				

Comment Category Codes:

T-1 - Comments that made a direct contribution to the task requirements (T-1 is a subcategory of All T)

All T- Task-oriented comments that related directly to the analysis task

All G- Group process comments that directed group effort or provided feedback

All S- Social and other non task-related comments

Discussion

The results of this study supported the authors' expectations regarding both hypotheses. Students were more productive in accomplishing task objectives and participated more uniformly when working together using computer-mediated communications. A larger study, using approximately ninety students, is planned for spring semester 1993 to follow up on the promising results of this study.

Several possible reasons for the increase in student productivity are suggested by the data summarized in Table 1. There are almost no group process or social interactions between students who are communicating through the computer network, resulting in a more task-focused work session. The depersonalized nature of electronic communications appears to discourage socialization and group interaction. Another possible reason for the increase in productivity may be related to the number of times that task-oriented comments were interrupted by someone else in the group. The number of interrupts per session ranged from 16 to 55, with a mean of approximately 31. Group process and social comments were interrupted frequently as well, but the interrupts to T comments represent the number of times that an individual was unsuccessful in getting out an idea that was task-oriented.

The competition for the opportunity to speak in face-to-face sessions that is evidenced by the interrupts may also provide a clue as to why not all students participate equally in collaborative problem-solving sessions. Students who are less

insistent on being heard will participate less. In a situation where there is not competition for air time, such as in sessions conducted using computer-mediated communications, those same students may dramatically increase their level of participation. Similarly, students who like to assume a leadership role in face-to-face meetings find it more difficult to control and lead a group when they are communicating electronically.

Computer-mediated communications can function effectively as an alternative means of teaching collaborative problem solving, particularly when the instructor would like to be able to grade individual student's contributions. The benefit of increasing task-focused behavior by students is also evident. The authors suggest the use of computer-mediated communications as a supplement to traditional face-to-face problem-solving sessions, not as a replacement. Valuable learning and teamwork experiences are embedded in the social and group process interactions that make up a large share of the communication in face-to-face meetings.

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